

and tail. No lateral series of large spines on the tail on this specimen, a male. A couple of large spines side by side in front of and near the dorsals, somewhat as in *R. clavata*. A group of large spines on the anterior extremity of each pectoral and a single row of retractile hooks on each near the outer angle. The greater portion of the disk is smooth. The claspers are long, slender, tapering, acutely pointed. Instead of bearing a sickle-shaped hook on its extremity, as in *R. erinacea*, the stylus of the clasper is forked and one of the slender branches becomes pointed and flexible and the other curved, expanded at the end, and sharp edged.

Total length 23; snout to vent, 11.5; snout to shoulder girdle, 6.75; snout to mouth 3, and greatest width 15.5 inches.

Color dark olivaceous, lighter toward margins, with white or translucent spaces at each side of the rostrum. Mottled and spotted with dark beneath the thoracic region. A rounded spot of light color around a dark center on each pectoral near the shoulder.

No. 16704. San Francisco, Cal.

Named for Prof. D. S. Jordan.

#### A REVIEW OF THE AMERICAN SPECIES OF FLYING FISHES (EXOCÆTUS).

By DAVID S. JORDAN and SETH E. MEEK.

In the present paper we have attempted to give the synonymy of the American species of *Exocætus*, with an analytical key by which those known to us may be distinguished. Some of the less-known forms we have described in detail.

There are few groups of fishes in which our knowledge is in a more confused state than in this. It is our hope that the present paper will, at least, not make matters worse. This paper is in some regards supplementary to that of Dr. Lütken (*Vidensk. Meddel. Naturh. Foren.* 1876), which is the only critical review of the species of this group thus far published.

It is evident that few, if any, of the flying-fishes are local in their distribution; many of them are certainly found in all warm seas. Several of the supposed East Indian forms will doubtless prove, on further comparison, to be identical with Atlantic species.

The multiplication of nominal species on characters peculiar to immature individuals has been carried to an unfortunate extreme. It is to be earnestly hoped that future writers who may possess specimens of bearded *Exocæti*, or of other young flying fishes of less than 5 or 6 inches in length, will content themselves with describing such specimens without imposing on them any new specific names. The changes due to increased age are often remarkable, and, in most cases, the supposed characters of species based on young specimens are characters of immaturity, common to the young of many flying fishes.

The material examined by us consists of the specimens in the collection of the museum of the Academy of Natural Sciences at Philadelphia, which have been very carefully studied by Mr. Meek; of the collections of the Indiana University, and of part of the *Exocæti* in the U. S. National Museum. Fifteen of the species here admitted have been studied by us, two others (*E. bahiensis*, *E. cyanopterus*) being known to us only from descriptions.

The species here noticed fall naturally into four subgenera or genera, for which we adopt the names *Fodiator*, *Parexocætus*, *Halocypselus*, and *Exocætus*. On the whole, it seems more convenient to treat these groups as genera, but whether genera or subgenera is not a matter of much importance.

Most of the species belong to the typical and most highly specialized genus, *Exocætus*. The other genera mark transitions in the direction of *Hemirhamphus*.

The name *Cypselurus*, has been used by Swainson, Weinland, and others for those species which are provided with one or two fleshy barbels or ribbons at the chin. These, we are fully convinced, are the young of other nominal species, which are destitute of barbels. It is probable that these appendages disappear at different ages in different individuals. In two species, *mesogaster*, usually described as destitute of barbels and *furcatus* described as with barbels, we have examined specimens both with and without these appendages.

ANALYSIS OF GENERA OF FLYING-FISHES.

- a. Roof of mouth (vomer, palatines, pterygoids) and tongue provided with teeth; body not angular in outline (elliptical in cross-section); pectoral fins moderate, not reaching beyond middle of dorsal fin; ventrals rather long, inserted behind middle of body; dorsal fin elevated; anal long, its base scarcely shorter than that of dorsal.
  - b. Snout long, slender, and pointed, much longer than eye; lower jaw acute, the tip much projecting (approaching *Hemirhamphus*)..... FODIATOR, 1.
    - bb. Snout short, much shorter than eye; lower jaw scarcely produced at tip.
      - PAREXOCÆTUS, 2.
  - aa. Roof of mouth and tongue, with few teeth or none; body angular in outline (a cross-section subquadrate); pectoral fins very long, their tips usually reaching nearly to base of caudal; lower jaw little prominent; snout short.
  - c. Ventral fins inserted anteriorly, much nearer tip of snout than base of caudal, not used as organs of flight, their tips not reaching nearly to front of dorsal; anal fin long, its base nearly equal to that of dorsal.
    - HALOCYPSSELUS, 3.
  - cc. Ventral fins inserted posteriorly, more or less nearer base of caudal than tip of snout, used as organs of flight, their tips reaching past middle of base of anal ..... EXOCÆTUS, 4.

GENUS I.—FODIATOR.

FODIATOR, genus nova (*acutus*).

This group, which seems to us of generic value, agrees with *Parexocætus* in dentition and in general characters, differing in the form of its jaws, which indicate a transition toward the genus *Hemirhamphus*. Per-

haps it should be considered as a subgenus under *Parexocætus*, but in any regard it seems desirable to allow it a distinct name.

But one species is known.

#### ANALYSIS OF SPECIES OF FODIATOR.

*a.* Snout long, about half longer than eye,  $2\frac{1}{2}$  in head; lower jaw much projecting, the half-beak at its symphysis about one-third the length of the snout. Origin of ventral fin midway between posterior margin of preopercle and last caudal vertebra. Pectoral fins half length of body, their tips reaching a little past front of dorsal; the first ray simple, about  $\frac{2}{3}$  length of the fin, the second ray divided. Ventrals  $1\frac{1}{2}$  in length of head, their tips scarcely reaching front of anal. Dorsal and anal fins inserted opposite each other, the base of the anal slightly shorter than that of dorsal. Dorsal fin high, its longest ray  $1\frac{1}{2}$  in head. Head  $3\frac{1}{2}$  in body; depth 5; eye  $3\frac{3}{4}$  in head. Color blue above, silvery below. Pectoral fins black on their posterior half, shading into lighter posteriorly; a large black blotch on the upper  $\frac{2}{3}$  of anterior rays of dorsal; ventrals and anal white; caudal dusky. . . . . ACUTUS, 1.

#### 1. *Fodiator acutus*.

*Exocætus acutus*, Cuvier & Valenciennes, Hist. Nat. Poiss., 1849, 125 (Surinam; Nice); Günther, Cat. Fish. Brit. Mus. 1866, 281 (about 100 miles off Fernando Po).

*Habitat*.—Tropical America; ? Mediterranean.

This interesting species is known to us from a single specimen in the museum of the Academy. It is  $6\frac{1}{4}$  inches in length, and was brought by Dr. Ruschenberger from Panama.

#### GENUS II.—PAREXOCÆTUS.

PAREXOCÆTUS, Bleeker, Nederl. Tydschr. Dierk. iii, 1865, 105 (*mento*).

This genus appears to be sufficiently distinct from *Exocætus*, differing in the form of the body as well as in the dentition. The species are small in size and apparently few in number.

#### ANALYSIS OF SPECIES OF PAREXOCÆTUS.\*

- a.* Pectoral fins of moderate length, their tips not reaching past middle of dorsal fin; origin of ventrals behind middle of body, their tips about reaching first ray of anal; body not angulated, elliptical in section; roof of mouth with teeth; snout short, shorter than eye, not pointed; lower jaw not produced.
- b.* Ventrals inserted at a point midway between pupil and last caudal vertebra, their tips reaching slightly past front of anal. D. 12; A. 13. First ray of pectoral about  $\frac{2}{3}$  length of second, which is divided; dorsal fin very high; its anterior rays reaching base of caudal; caudal short; lower jaw little obtuse, with a very slight symphyseal knob. Body deep blue above; fins all pale, except the dorsal, which has a large black blotch on its anterior rays. . . . . MESOGASTER, 2.
- bb.* (Ventrals inserted at a point midway between tip of snout and base of caudal, their tips reaching first ray of anal. D. 11, A. 13. Snout very short; lower jaw with a very small pointed tubercle at the chin; pectoral fins half length of body; dorsal high and pointed. . . . . MENTO.)

\* For purposes of comparison, we add here the characters of the type of the genus, *Parexocætus mento*, from the Pacific. The latter species may perhaps not be distinct from *E. mesogaster*. *E. brachypterus*, Solander, a species provided with two short barbels at the chin, is doubtless identical with *E. mento*, as already suggested by Dr. Günther. As Valenciennes states that the little tubercle at the chin in *E. mento* "forms a vestige of half-beak before the mouth," we do not venture to place it in the synonymy of *E. mesogaster*.

2. *Parexocetus mesogaster*.

*Exocetus mesogaster*, Bloch, Ichthyologia, pl. 399 (on a drawing by Plumier); Bloch & Schneider, Syst. Ichth., 1801, 430 (copied); Mitchill, Trans. Lit. and Phil. Soc. 1815, 443 (Southern coast); Cuv. & Val., xix, 1846, 87 (Cuba); Poey, Syn. Pisc. Cubens., 1868, 385 (copied); Poey, Enumeratio Pisc. Cub. 1875, 122 (copied); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 588 (Charleston); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1883, 143 (Pensacola; no descr.).

*Parexocetus mesogaster*, Jordan, Proc. U. S. Nat. Mus., 1884, 34 (Pensacola; no descr.).

? *Exocetus orbignianus*, Cuv. & Val., xix, 131, 1846 (Montevideo; based on a drawing); Günther, vi, 285 (copied).

*Exocetus hillianus*, Gosse, Nat. Sojourn Jamaica, 1851, ii, tab. 1, f. 1 (Jamaica); Poey, Memorias, ii, 1861, 301 (Cuba); Poey, Syn. Pisc. Cub., 1868, 384 (Cuba); Poey, Enumeratio Pisc. Cub., 1875, 122; Lütken, Vid. Medd. Naturh. Foren., 1876, 397 (Atlantic; Antilles; Honolulu); Cope, Trans. Am. Phil. Soc., 1871, 451 (St. Martin's); Jordan & Gilbert, Syn. Fish. N. A., 1883, 903; Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 262 (Pensacola).

*Exocetus gryllus*, Klunzinger, Fische des Rothen Meeres, 1870, 586 (Red Sea; fide Lütken).

*Habitat*.—East Indies; West Indies, north to Newport.

This little flying-fish is the most abundant species along our South Atlantic coast. We have adopted for it the name *mesogaster*, believing it to be the original *mesogaster* of Bloch, as well as the *mesogaster* of Mitchill and of Valenciennes, although none of these writers have given descriptions of any value.

The *hillianus* of Gosse is of course the present species. Lütken states that the *gryllus* of Klunzinger is also the same, the alleged distinctive character of the latter not really existing.

The *orbignianus* of Cuv. & Val. seems to have been based on a poor drawing of the present species.

Three specimens of this species are in the museum of the Academy—one 7 inches long from the Sandwich Islands, one 5½ inches long from Newport, R. I., and one 4¼ inches long from St. Martin's. The one last mentioned has two short barbels on tip of lower jaw. These barbels are ribbon-shaped, black, and about three-fifths diameter of the eye. In the specimen from Newport there are also barbels, but much less developed than in the former specimen. In the Sandwich Island specimen no barbels exist. Otherwise the three agree closely, and evidently all belong to the same species. Specimens from Florida in the United States National Museum and in the museum of the Indiana University have no barbels, but otherwise agree with the others.

It is evident that the barbels constitute a character of youth, in this species at least.

The following description is taken from the specimen above noted, from the Sandwich Islands:

Head 4⅔ in length of body; depth, 5; D, 12; A, 13; about thirty-eight scales in the lateral line, five rows of scales between lateral line and dorsal fin.

Body elongate, compressed (not angulated), rather deep; width of body at base of pectorals, 2 in head; head narrow, compressed, almost trenchant below; interorbital area flattish, about as wide as eye, 3 in head.

Snout short, rather pointed; its length  $4\frac{1}{4}$  in head; teeth on tongue and palatines; gill rakers numerous, long and slender; pectoral fins of moderate length; their length  $1\frac{2}{3}$  to 2 in length of body; their tips reaching middle of base of dorsal fin; second ray of pectorals divided; dorsal fin very high, its longest rays about  $\frac{1}{6}$  longer than head; base of dorsal about  $1\frac{1}{2}$  in length of head; tips of anterior rays of dorsal reaching beyond tips of posterior rays when the fin is deflexed, and reaching almost to base of caudal fin. Ventrals rather short,  $4\frac{3}{4}$  in length of body, their tips reaching slightly past origin of anal fin. Origin of ventrals midway between pupil and last caudal vertebra. Anal fin opposite dorsal. Lower lobe of caudal rather short, slightly longer than head. Color blue above; silvery below. Pectorals (dusky in the young) becoming nearly white in the adult; color of ventrals very similar to pectorals, the duskiess in the young formed of fine blackish dots. Upper half of anterior rays of dorsal fin black. Anal fin with few small black dots, more numerous in the young; caudal dusky reddish.

### GENUS III.—HALOCYPSELUS.

HALOCYPSELUS, Weinland, Proc. Bost. Soc. Nat. Hist., 1859. 385 ("mesogaster"\*  
Weinland = *evolans*.)

This genus is distinguished from *Exocetus* chiefly by the small size and anterior position of the ventrals. There are probably but two species, one of them, *H. evolans*, being the most widely distributed of all the flying fishes; the other, *H. holubi* Steindachner, is known only from the west coast of Africa. This species differs from *H. evolans* chiefly in the much higher dorsal.

#### ANALYSIS OF SPECIES OF HALOCYPSELUS.

*a* Origin of ventral fins midway between tip of snout and last ray of anal; length of ventrals half length of head. Pectorals  $1\frac{1}{2}$  in length of body, their tips reaching base of caudal; first ray of pectoral simple; second divided. Anal fin long, scarcely shorter than dorsal, its first ray usually opposite to first ray of dorsal. Dorsal low, its first ray less than half head. Lower lobe of caudal about one-fourth longer than head. Snout rather blunt,  $4\frac{1}{2}$  in head; interorbital area flattish, 3 in head. Eye  $3\frac{3}{8}$  in head. Head 4 in length; depth  $5\frac{1}{8}$ . D. 13; A. 13. Scales about 42. Pectoral fins dark above, with the lower margins white; no white oblique cross-bar. Ventrals white. Caudal dusky. Dorsal and anal pale, without black markings; a white streak along base of anal, wider and more conspicuous anteriorly ..... EVOLANS, 3.

\* Although Dr. Weinland refers to *E. mesogaster* as the type of *Halocypselus*, it is evident from his description that he had *E. evolans* in mind. He says: "In *E. mesogaster* the ventrals are very short, about one-fourth as long as the pectorals, and placed anterior to the middle of the body, between the anus and the pectorals; the shape of the lower jaw is also angular." For the *mesogaster*, thus diagnosed, he proposes a new genus, *Halocypselus*.

**3. Halocypselus evolans.**

- Exocetus, pinnis ventralibus brevissimus*, Gronow, Zoöphylac., 358 (Spain).  
*Exocetus evolans*, Linnæus, Systema Naturæ, xii, 1766, 521 (based on Gronow); Gmelin, Systema Nat., 1789, 1400 (copied); Bloch, Ichthyol., 9, pl. 398. Walbaum, Artedi, Pisc., 1792, 49 (copied); Bloch & Schneider, Syst. Ichth., 1801, 43, pl. 84; Shaw, General Zoology, v, 1804, 144, f, 117; Turton, Linnæus, 1806, 867 (copied); Cuvier & Valenciennes, xix, 1846, 138; (Mediterranean Sea; Brittany; Morbihan; Newfoundland; Antilles; Bahia; Rio Janeiro; Ceylon; Arabia; Cape Verde; New Zealand; New Holland, &c.); Günther, vi, 1866, 282 (Mediterranean; Demerara; Zanzibar; Seychelles; Java; India; China; Australia); Steindachner, Ichthyol. Berichte, 1868, 68 (Taragona); Lütken, Vidensk. Meddel. Nat. Foren, 1876, 395, 102 (many seas); Day, Fish. Great Britain, 1883, 126, pl. 129.
- Halocypselus evolans*, Gill, Rept. U. S. Fish Comm., 1872-'3; Jordan & Gilbert, Proc. U. S. Nat. Mus., 1878, 283 (Beaufort, N. C.; no descr.); Jordan & Gilbert, Syn. Fish N. A., 1883, 377.
- Exocetus volitans*, Lacépède, Hist. Nat. Poiss., v, 1798, 401, pl. 12, f. 2; Yarrell, Hist. Brit. Fishes, 1836, 398, ed. 2, 433 (British Channel); Bennett, Whaling Voyage, ii, 1840, 284. (Not of Linnæus).
- Exocetus splendens*, Abel, Narr. Voyage China, 1818, 4 (*vide* Val.).
- ? *Exocetus georgianus*, Cuv. & Val., 1846, xix, 139 (5° S., 92° W.); Günther, vi, 1866, 279 (copied); Lütken, Vid. Medd. Nat. Foren, 1876, 394, 101 (west of Sandwich Islands 31° S., 47° E.). (Young examples, with barbel.)
- ? *Exocetus monocirrhus*, Richardson, Ichth. China, 1846, 265 (China); Günther, vi, 1866, 279 (copied). (Young examples, with barbel.)
- Exocetus chilensis*, Abbott, Proc. Ac. Nat. Sci. Phila., 1860, 472 (Chili).
- Exocetus obtusirostris*, Günther, vi, 1866, 283 (Cape Verde Islands; India; New Orleans); Lütken, Vid. Medd. Naturh. Foren, 1876, 395 (many seas); Steindachner, Beiträge, Kenntniss Fische Afrika's, 1881, 38 (Gaboon).
- Halocypselus obtusirostris*, Jordan & Gilbert, Syn. Fish N. A., 1883, 378 (copied).

*Habitat.*—Warm seas; cosmopolitan.

Of all the flying-fishes this species seems to have the widest range, and it is the one most common in collections.

We are unable to distinguish the *obtusirostris* of Günther from *evolans*, the characters assigned to the former by Lütken, as well as those mentioned by Günther, seeming to come within the range of individual variations. The two forms have the same geographical range, and Lütken remarks that "although in most cases it is easy enough to decide to which species any specimen belongs, yet there are some in which this determination seems to be almost arbitrary; therefore I am not fully convinced of their specific independence."

The *chilensis* of Abbott is unquestionably *evolans*. The type is still preserved in the museum of the academy at Philadelphia, where it has been examined by us. The fin rays are D. 14, A. 13, not "D. 16," "A. 15," as stated by Dr. Abbott.

None of the numerous young examples examined by us show any trace of barbels at the chin. It is, however, not impossible that other

young individuals may be found still retaining these appendages. Lütken observes that *E. georgianus* Cuv. & Val. should "have its place beside *E. evolans* and *E. obtusirostris*, but it differs in this respect, that it is provided with barbels; it is even a question if the examples which have lost these could be distinguished from the species above-named."

As none of the specimens of *E. georgianus* examined by Dr. Lütken exceed  $2\frac{3}{4}$  inches in length, we regard them, in view of what we already know of the loss of these appendages in *furcatus* and *mesogaster*, as, without much doubt, young individuals of *evolans*.

The "*monocirrus*" of Richardson is, according to Lütken, undoubtedly identical with *E. georgianus*.

The color of very young specimens of *evolans*, less than  $1\frac{1}{2}$  inches in length, is bluish above, silvery below. There is a brownish band across the body at base of caudal fin; a second band around body covers posterior half of dorsal and fins; some black on ventrals and on posterior half of pectorals.

In a larger specimen there are no bands on the body, the ventrals are white and the pectorals mostly dark. The length of the pectoral bears about the same proportion to the length of the body in both old and young specimens. The same is true of the proportionate length of the first and second rays of this fin.

Specimens of  $\frac{3}{4}$  inch to 9 inches in length are in the museum of the Philadelphia Academy. These are from the Atlantic and Indian Oceans, the Bahamas, the Sandwich Islands, and from Chili. We have examined others from North Carolina and the West Indies.

#### GENUS IV.—EXOCÆTUS.

##### *Exocætus*.

EXOCÆTUS, Artedi, Genera Piscium, 6, 1738 (*volitans*).

EXOCÆTUS, Linnæus, Systema Naturæ, ed. x, 1758, 316 (*volitans*).

CYPSELURUS, Swainson, Class'n Fishes, etc., ii, 1839, 296 (*nuttalli*).

This group includes most of the species of flying-fishes. Its species are in general larger in size than those of the other groups, and their wing-like paired fins are more extensively developed. As already stated, we regard *Cypselurus* as unworthy of consideration as a genus, the barbels being in most cases, and probably in all, characteristic of young fishes.

##### ANALYSIS OF SPECIES OF EXOCÆTUS.\*

- a. Anal fin long, its base a little less than that of the dorsal, its first ray nearly opposite first ray of dorsal; rays of anal 11 to 12.
- b. Second ray of pectoral simple (as well as the first); third ray divided; fourth and fifth rays longest.

\* We here omit (No. 12) *E. cyanopterus* and its doubtful synonym, *E. albidactylus*, the descriptions of both being incomplete.

- c. Second ray of pectoral about as long as first ray; ventral fins inserted midway between posterior margin of eye and base of caudal (*i. e.*, end of last caudal vertebra); ventral fins  $2\frac{2}{3}$  in length of body, their tips reaching base of caudal; dorsal high, the longest rays about  $1\frac{1}{2}$  in head; pectoral fins reaching base of caudal,  $1\frac{1}{3}$  in length. Head, 4 in length; depth,  $5\frac{1}{2}$ ; scales about 48; eye,  $2\frac{1}{8}$  in head. Pectorals and ventrals marbled with black and white; dorsal fin with a black spot on upper part of anterior rays; anal white; a dusky blotch at base of caudal ..... EXLIENS, 4.
- cc. Second ray of pectoral about half longer than first; ventral fins inserted midway between middle of preopercle and last caudal vertebra; ventrals  $3\frac{1}{2}$  in body, their tips reaching last rays of anal; length of pectorals  $1\frac{1}{8}$  in body, their tips reaching nearly to base of caudal fin; first ray of pectoral about half length of longest ray; dorsal moderate, its longest rays  $2\frac{2}{3}$  in head; head  $4\frac{1}{2}$  in length of body; depth  $5\frac{1}{2}$ . D. 11; A. 11 or 12. Scales 50: 25 before ventrals and 28 before dorsal. Snout short and blunt, 4 in head; eye  $3\frac{1}{2}$ ; interorbital space  $2\frac{1}{2}$ . Pectoral fins uniform dusky, with paler edgings. Ventrals nearly black mesially, darker on their posterior half; no black markings on dorsal and anal fins..... RONDELETI, 5.
- bb. Second ray of pectoral divided; first ray simple; third and fourth longest.
- e. Origin of ventrals midway between posterior margin of orbit and last caudal vertebra; ventrals chiefly black; pectorals  $1\frac{1}{2}$  in body, reaching last ray of dorsal; ventrals about 3 in length of body, their tips reaching slightly beyond last ray of anal; longest dorsal ray  $2\frac{1}{2}$  in head; lower lobe of caudal  $3\frac{1}{2}$  in body; head  $4\frac{1}{3}$  in length; depth,  $6\frac{1}{3}$ . D. 11; A. 12. Scales about 48: 24 before ventrals, 28 before dorsal, 7 between dorsal and lateral line. Snout  $4\frac{1}{2}$  in head; eye, 3; interorbital area nearly flat,  $2\frac{1}{2}$  in head. Pectoral fins dusky, nearly uniform, or with a small white oblique bar, which extends half way across the fin; the edges of the fin whitish; ventrals chiefly blackish; dorsal and anal without dark markings ..... VINCIGUERRÆ, 6.
- ee. Origin of ventrals midway between posterior margin of preopercle and last caudal vertebra; ventrals pale, with a dusky shade in the axil.
- f. Pectoral fins not uniform in color, dark brown, with an oblique, whitish band which begins in the axil and runs obliquely backward to middle of fin; edges of pectorals whitish. Pectoral fins  $1\frac{1}{8}$  in length of body, their tips reaching beyond dorsal. Ventrals  $3\frac{1}{2}$  in body, reaching about to ninth ray of anal; longest dorsal ray  $2\frac{1}{2}$  in head, anal ray 3; lower lobe of caudal  $3\frac{1}{2}$  in body. Head  $4\frac{1}{2}$  in body; depth,  $6\frac{1}{3}$ . D. 12; A. 11. Scales, 55: 25 before ventrals; 30 before dorsal; 6 rows between dorsal and lateral line. Snout rather obtuse, 4 in head; eye large,  $2\frac{1}{2}$  in head; interorbital space slightly concave,  $2\frac{2}{3}$  in head; width of body at base of pectorals  $1\frac{1}{4}$  in head; ventral fins white, with a slight dusky shade in the axil; no dark markings on dorsal or anal..... VOLITANS, 7.

- ff.* Pectoral fins nearly uniform brownish, without oblique pale bar. Length of pectorals,  $1\frac{5}{7}$  in body, their tips scarcely reaching last ray of dorsal. Ventrals,  $3\frac{1}{2}$  in body, scarcely reaching last ray of anal. Head,  $4\frac{1}{8}$  in length; depth,  $5\frac{1}{2}$ . D. 11, A. 12. Scales about 58; 27 before ventrals, 30 before dorsal; 6 rows between lateral line and dorsal. Snout rather long, equal to eye,  $3\frac{1}{2}$  in head. Interorbital area flat, 3 in head. Ventrals scarcely dusky, without distinct markings; dorsal and anal plain. . . . RUFIPINNIS, 8.
- aa.* Anal fin short, its base one-half to two-thirds length of base of dorsal; its insertion behind first ray of dorsal; its rays 9 or 10.
- h.* Second ray of pectoral divided (first simple); third and fourth rays longest.
- i.* Pectoral fins without round dark spots.
- j.* Ventral fins inserted about midway between pupil and last caudal vertebra.
- k.* Dorsal and anal fins without black markings; ventrals pale.
- l.* Base of anal  $1\frac{3}{8}$  in base of dorsal; pectoral  $1\frac{1}{2}$  in length, reaching last ray of dorsal; ventrals  $2\frac{1}{2}$  in body, reaching last ray of anal; snout,  $3\frac{3}{4}$  in head; eye,  $3\frac{1}{2}$ . Head,  $4\frac{1}{2}$  in body; depth,  $5\frac{1}{2}$ . Scales, 58: 26 before ventrals, 33 before dorsal, 7 rows of scales between dorsal and lateral line; D. 14, A. 9. Lower lobe of caudal about  $\frac{1}{4}$  longer than head. Pectoral fins with an oblique white band across lower half of fin; dorsal and anal plain; ventrals white, their axil scarcely dusky . . . . . HETERURUS, 9.
- ll.* Base of anal 2 in base of dorsal; length of pectorals  $1\frac{3}{8}$  in length of body, their tips reaching end of dorsal fin; length of ventrals  $2\frac{3}{8}$  in body, their tips nearly reaching last ray of anal; last ray of anal opposite last of dorsal; lower lobe of caudal about  $\frac{1}{2}$  longer than head; snout little pointed,  $4\frac{1}{2}$  in head. Eye,  $2\frac{3}{4}$ : scales 50; 23 before ventrals; 28 before dorsal; seven rows of scales between dorsal and lateral line. Head  $4\frac{1}{2}$  in length; depth  $5\frac{1}{2}$ . D. 14, A. 9. Interorbital area flat; 3 in head. Pectorals black on posterior half; paler on anterior half, with an oblique white bar, which begins in axil and extends two-thirds distance across the fin; edge of pectorals white; ventrals white; the axil a little dusky; dorsal and anal plain; caudal dusky, with a dusky vertical shade across middle rays. . . . . ROBUSTUS, 10.
- kk.* Dorsal and anal fins marked with black; dorsal with one or more dark blotches; anal with a black spot on tips of third to sixth rays; ventrals black, with pale edgings, and a white spot near its base; pectorals black, with a white band running from axil obliquely backward to tips of upper rays; caudal with three dusky cross-bars. Pectorals long,  $1\frac{2}{3}$  in body, not quite reaching last dorsal ray; ventrals  $2\frac{1}{2}$  in body, their tips nearly reaching base of caudal; lower lobe of caudal  $3\frac{1}{2}$  in head. Head  $4\frac{1}{2}$  in length; depth  $5\frac{1}{2}$ . D. 13, A. 9. Scales about 46; 8 rows between dorsal and lateral line. . . . FURCATUS, 11.
- jj.* Ventral fins inserted midway between posterior margin of preopercle and last caudal vertebra. Pectorals not uniformly colored; posterior half of pectorals, ventrals, and dor-

- sal rather abruptly black; anal white. Length of pectoral fin  $1\frac{1}{2}$  in body, its tip reaching nearly to base of caudal; first ray of pectoral  $1\frac{1}{2}$  in length of longest; ventrals  $2\frac{1}{2}$  in length of body, their tips reaching tip of last ray of anal; dorsal rather high, its longest rays  $1\frac{1}{2}$  in head; longest anal ray  $3\frac{1}{2}$  in head; lower lobe of caudal about  $\frac{1}{4}$  longer than head. Head  $4\frac{1}{2}$  in body; depth  $5\frac{1}{2}$ . D. 14, A. 9. Scales about 52: 27 before the ventral fins; 26 in front of dorsal. Snout 4 in head; eyes  $3\frac{1}{2}$  in head; interorbital space broad, slightly concave, its width  $2\frac{2}{3}$  head; depth of head  $1\frac{2}{3}$  in its length. . . . NIGRICANS, 13.
- jjj.* Ventral fins inserted at a point midway between middle of opercle and last caudal vertebra (or between tip of snout and tip of upper lobe of caudal).
- m.* [Dorsal fin with a large blackish blotch; pectorals nearly uniformly dusky; ventrals bluish white. Tip of pectorals reaching end of dorsal; tip of ventrals reaching middle of anal; insertion of ventral midway between tip of snout and that of upper lobe of caudal; dorsal fin of medium height inserted much in advance of anal. Snout  $\frac{2}{3}$  length of eye, which is  $3\frac{1}{2}$  in head. Head  $5\frac{1}{2}$  in total length (with caudal); depth  $6\frac{1}{2}$ . D. 13, A. 9 or 10. Scales 50.] (*Günther.*) . . . . . BAHIENSIS, 14.
- mm.* Dorsal fin pale, somewhat dusky above, without distinct black blotch; ventrals mesially blackish, the margins paler; dorsal rather pale, somewhat dusky above; pectorals mostly dusky, with the posterior edges paler; an obscure oblique pale band across lower part. Pectorals  $1\frac{2}{7}$  in length of body, their tips reaching caudal fin. Ventrals  $3\frac{3}{4}$  in body, their tips reaching middle of anal. Lower lobe of caudal about one-third longer than head. Head  $4\frac{1}{2}$  to 5 in length of body; depth, 6. D. 12, A. 10. Snout, 4 in head. Eye,  $3\frac{1}{3}$  in head. Base of anal,  $1\frac{1}{2}$  in base of caudal. Scales, about 60. . . . CALIFORNICUS, 15, 16.
- ii.* Pectoral fins covered with small round dark spots; the edges paler; ventral fins pale, the middle rays grayish, obscurely spotted; other fins pale. Pectoral fins reaching to end of dorsal; ventral fins inserted midway between preopercle and base of caudal, their tips reaching nearly to base of anal. Dorsal fin rather high, its anterior rays about half length of head. Distance between first dorsal ray and first rudimentary ray of caudal equal to length of head. Scales, 46: 34 before the dorsal fin, and 9 between lateral line and dorsal fin. Head nearly 4 in length (to base of caudal); depth, 5. D. 11 or 12, A. 8. Snout obtuse and depressed, three-fifths diameter of eye, which is 3 in head, and less than width of interorbital space, which is slightly concave . . . . . CALOPTERUS, 16.
- hh.* Second ray of pectoral simple (like the first); third ray divided.
- n.* Snout more obtusely descending than in any other species, its length  $4\frac{1}{2}$  in head; eye 3 in head; interorbital area slightly concave, about  $\frac{1}{4}$  wider than eye; ventrals inserted midway between posterior margin of orbit and last caudal vertebra; their length  $2\frac{2}{10}$  in body, their tips reaching last ray of anal; pectorals  $1\frac{2}{3}$  in body, their tips

reaching last ray of dorsal. Head 4 in length; depth  $5\frac{1}{2}$ . D. 12, A. 9. Scales 46. Pectoral fins dusky, darker towards their tips; ventrals dusky, nearly black mesially, paler towards the edges; dorsal and anal without dark markings; caudal dusky; a faint dark streak along each row of scales on upper part of body.....GIBBIFRONS, 17.

#### 4. *Exocoëtus exiliens*.

*Exocoëtus exiliens*, Gmelin, Systema Naturæ, 1788, 1400 (Carolina); Turton, Linnæus, 867, 1806. (Copied.)

? *Exocoëtus exiliens*, Cuv. & Val., 1846, xix, 114 (New Jersey); ?Günther, vi, 1866, 291. (Copied.)

*Exocoëtus exiliens*, Walbaum, Artedi, Piscium, 1792, 50. (Copied.)

*Exocoëtus fasciatus*, Le Sueur, Journ. Acad. Sci. Phila., 1821, 10, pl. 4, f. 2. (Atlantic.)

*Exocoëtus lamellifer*, Kner & Steindachner, Neue Fische. Mus. Godeff., 1866, 29. (12° S., 33° W.); Lütken, Vidensk. Meddel. Naturh. Foren., 1876, 405, 11. (Atlantic, Indian, and Pacific Oceans.)

*Habitat*.—Atlantic, Indian, and Pacific Oceans.

Head 4 in length of body; depth  $5\frac{1}{2}$ ; D. 11; A. 11; 48 scales in lateral line. Body little compressed, angulated. Head broad; interorbital space slightly concave; snout rather blunt, short,  $4\frac{2}{3}$  in length of head; interorbital area  $2\frac{1}{4}$  in head; eye  $2\frac{1}{3}$  in head; lower jaw slightly longer than upper.

Pectorals long and broad,  $1\frac{1}{3}$  in length of body, their tips reaching base of caudal. First two rays of pectoral simple and of equal length, their length  $2\frac{1}{3}$  in length of fin, and connected to each other and to third ray by rather broad membranes.

Ventrals long,  $2\frac{1}{3}$  in body, their tips reaching base of caudal fin.

Origin of ventrals midway between posterior margin of orbit and last caudal vertebra. Last rays of dorsal and anal fins opposite each other. Base of anal slightly shorter than that of dorsal. Dorsal rather high, its longest ray  $1\frac{2}{3}$  in head; longest ray of anal  $1\frac{3}{4}$  in head.

Color brownish above, silvery below. Pectorals and ventrals marbled with black. Dorsal with a black spot on upper part of its anterior rays. Lower caudal lobe with a black spot about  $\frac{1}{3}$  distance from its base. Breast with three black cross-bands. Anal fin white.

The above description is taken from a single specimen in the museum of the Philadelphia Academy. It is  $2\frac{3}{4}$  inches in length, and was obtained by Mr. W. H. Jones at 31° 30' N., 36° 36' W., during a cruise of the Constitution.

We regard this species as, with little doubt, the original *Exocoëtus exiliens* of Gmelin. Gmelin's species is evidently one of those with long anal and with the fins banded with black. The first and second rays of the pectoral are said to be both short, a character which distinguishes this species at once from *E. rondeleti*.

The following is Gmelin's description :

*Exiliens*. 3. E. pinnis ventralibus caudam attingentibus. D. 10, P. 15, V. 6, A. 11, C. 20

"Habitat ad Carolinam, volitanti statura simillimus, at vix digito longior, neque argenteus. Garden.

"Pinnæ pallidæ, fascia una alterave nigricante, ventrales, quæ in volitante ne anum quidem attingunt, apice pinnam caudæ attingentes,  $\frac{1}{4}$  a cauda remotæ, ceterum, uti in volitante, inter caput et anum mediæ, radio primo brevi, pectorales radio primo et secundo brevibus; caudalis lobus inferior longior."

The specimen examined by us agrees very closely with the description and figure of *lamellifer* given by Kner and Steindachner. It agrees also with Lütken's account of the same species.

The *fasciatus* of Le Sueur seems to be, in all probability, the same fish. The figure is very poor, and the description meager, but apparently one of the species with long anal is indicated, probably *exiliens* rather than *volador*, especially as the first and second pectoral rays are figured as nearly equal in length.

All the known specimens of *exiliens* are young fishes, and it is barely possible that *E. rondeleti* is the adult of the same species. The differences in the length of the second ray of the pectoral and in the height of the dorsal seem, however, hardly likely to be due simply to differences of age. The *Exocætus exiliens* of Cuvier & Valenciennes is indeterminable from the description. It may be the young of *E. exiliens*, *rondeleti* or *vinciguerræ*. *Exocætus nigripinnis* and *E. brachycephalus* Günther seem to be closely allied to *E. exiliens* and *E. rondeleti*.

##### 5. *Exocætus rondeleti*.

*Mugil alatus*, Rondelet, De Piscibus, ix, 207, 1554.

*Exocætus rondeleti*, Cuv. & Val., xix, 115, 1846 (Naples, Sicily, Canaries); Günther, 1866, 293 (copied); Steindachner, Ichthyol. Bericht., 1868, 69 (east coast of Spain, Sicily, Triest); Vinciguerra, Risultati Ittiologici del Violante, 1883, 110 (Malta, Toulon, Tripoli, Lipari, Naples, Genoa, Nice).

† *Exocætus brachycephalus*, Günther, vi, 1866, 297. (China.)

*Exocætus brachycephalus* (in part?), Lütken, Vidensk. Meddel. Naturh. Foren. 1876, 110, 405 (Atlantic, Nice, Acapulco, &c.).

† *Exocætus exiliens*, Goode, Bull. U. S. Nat. Mus., v, 64, 1875 (Bermudas); Jordan & Gilbert, Syn. Fish. N. A., 1883, 380 (copied).

*Exocætus volador*, Jordan, Proc. U. S. Nat. Mus., 1884, 34. (Pensacola.)

*Habitat*.—Tropical seas, north to Florida and France.

Our specimens agree very closely with Günther's description of *E. brachycephalus*. His species seems, however, to be slenderer than ours (depth  $6\frac{1}{2}$  in length), the head shorter (5), and the dorsal much higher (its longest rays more than half head). The specimens noticed by Lütken as *E. brachycephalus* from the Atlantic seem to be the young of this species. The largest of our specimens have (as is stated in the original description of *E. volador*) the first ray of the pectoral about half the length of the fin, the second ray two-thirds. A younger specimen (7 inches) has the first ray of the pectoral about one-third the length of the longest, one-half the length of the second. Lütken finds the first

ray scarcely one-third the longest, the second about one-half the longest, or a little more, and not two-thirds the third ray. This species, then, is subject to some variations in this regard.

We must, then, with Lütken, "leave undecided, for the present, the question of the number of actual species among the forms which group themselves around *E. brachycephalus*."

The *Exocetus exiliens* of Goode is probably the present species, rather than *E. vinciguerræ* or *E. exiliens*. The second ray of the pectoral is said to extend beyond the membrane in a spine-like process. This apparently implies that it is a simple ray, while the shortness of the first pectoral ray, as compared with the second, precludes the possibility of Professor Goode's specimen having been a true *exiliens*.

We had at first, following Lütken and Bleeker, regarded the following species as the true *rondeleti* of Cuv. & Val., although the description of the latter author applies equally well to the present species.

Dr. Vinciguerra has, however, shown conclusively that the true *rondeleti* must be the species with the second pectoral ray simple, and according to Dr. Sauvage (quoted by Vinciguerra) the original types of the *E. rondeleti* show this character. The name *volador* becomes, therefore, a synonym of *rondeleti*. For a full discussion of the species, which appears to be one of the most common in the Mediterranean, the reader is referred to the "Risultati Ittiologici del Violante" of Dr. Vinciguerra.

The assertion of Moreau (Hist. Poiss. France, iii, 353), that in the same individual the second ray of the pectoral is sometimes entire on one side and split on the other, needs verification.

Of this species we have examined the original type of *Exocetus volador* 9¼ inches long (34975 U. S. N. M.) from Pensacola, and three specimens in the museum of the Academy. One of these, from the Bonaparte collection, taken in the Atlantic, is 7 inches long; one, 10 inches long, is from the Gulf of Mexico (Dr. J. Carson), and a third, 9 inches long, from the Atlantic. A specimen from near the Island of St. Thomas is in the museum of the High School at Battle Creek, Michigan.

6. *Exocetus vinciguerræ*, nom. sp. nov. (21870, U. S. N. M.).

*Exocetus rondeleti*, Lütken, Vidensk. Meddel. Foren., 1876, 404 (Atlantic); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 263; Jordan & Gilbert, Syn. Fish. N. A., 1883, 904 (open sea, 46° N.; 61° W.); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 263 (not of Cuv. & Val.).

*Exocetus ? exiliens*, Vinciguerra, Risultati Ittiologici del Violante, 1883, 113 (not of Gmelin).

*Exocetus vinciguerræ*, nom. sp. nov.

*Habitat*.—Atlantic.

As already noticed, the description of Cuvier & Valenciennes of their *E. rondeleti* is insufficient for discrimination among the species with long anal and black ventrals. Lütken, Bleeker, and Jordan & Gilbert have applied the name *rondeleti* to the present species, leaving for the other the name "*brachycephalus*" or "*volador*." Dr. Vinciguerra has, however, shown that the original *rondeleti* is the preceding species,

the *volador* of Jordan. The species with the second ray of the pectoral divided is thus left without a name, and we suggest that of *Exocætus vinciguerræ* in honor of our excellent friend, the ichthyologist of the Museo Civico at Genoa, who was the first to show the correct application of the name *rondeleti*.

Of this species we have examined three examples. One, which may be regarded as the type of *Exocætus vinciguerræ* (No. 21870, U. S. Nat. Mus.), is from the open sea south of Newfoundland. Two others are in the museum of the academy. One of these is  $6\frac{1}{4}$  inches long, from the Gulf of Mexico (Dr. J. Carson), and the other,  $3\frac{1}{2}$  inches long, from St. Martin's (Dr. R. V. Rijgersma).

The young of this species, like that of *E. exiliens*, has the paired fins marbled. The first rays of the pectoral are also separated by a broad membrane in the young of this, as of other species.

#### 7. *Exocætus volitans*.

*Exocætus*, Artedi, Genera Piscium, 1738, 18, et Syn. Nov. Pisc., 1738, 35 (locality not specified); Balk. Amœnitates Acad. (Mus. Adolph-Friederici), 1, 1749, 603 (after Artedi).

*Exocætus volitans*, Linnæus, Syst. Nat., x, 1758, 316 (after Balk.); Linnæus, xii, 1766, 522; Gmelin, Syst. Nat., 1788, 1399 (copied); Turton, Linnæus 1806, 866 (copied).

*Exocætus speculiger*, Cuvier & Valenciennes, Hist. Nat. Poiss., xix, 1846, 93 (Friendly Islands; Straits of Sunda; Isle of France; Indian Ocean, Peros-Banhos; Pacific coast of South America); Bleeker, "Ned. Tydskr. Dierk. iii, 1865, 122" (Pacific Ocean); Günther vi, 1866, 237 (Amboyna; Australia); Lütken, Vidensk. Meddel. Naturh. Foren., 1876, 403. 109 (Indian Ocean; Atlantic; Pacific; Arabian Sea; Honolulu; Mediterranean?); Hutton, Fish. New Zealand, 1872, 55 (New Zealand).

? *Exocætus noveboracensis*, Cuv. & Val. xix, 1846, 100 (Newfoundland; not of Mitchill).

? *Exocætus roberti*, Müller & Troschel, Schomburgk's Hist. Barbadoes, 1848, 675 (Barbadoes).

? *Exocætus quadriremis*, Gronow, Cat. Fish. in Brit. Mus., 1854, 145 (Spain and India).

*Exocætus affinis*, Günther vi, 1866, 288 (West Africa; Cuba?; Atlantic).

*Exocætus melanurus*, Jordan & Gilbert, Syn. Fish. N. A., 1833, 379; (not of Cuv. & Val.; specimen from off coast of New England).

*Exocætus exiliens*, Jordan & Gilbert, Syn. Fish. N. A., 1883, 904 (same specimen: not of Gmelin); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 263.

*Habitat*.—Tropical seas: north to New England.

The *Exocætus volitans* of Linnæus is based on the *Exocætus* of Artedi. The locality of the specimen described in detail by this author is not stated. There is no evidence that it came from the Mediterranean. It is evident from the numbers of the fin-rays that Artedi's example did not belong to the species called *volitans* by Cuv. & Val. As the rays of the dorsal and anal are each stated to be eleven, the name *volitans* must be reserved for one of the species with the anal fin long. The ventral fins are said to be white, which fact excludes from considera-

tion *exiliens*, *rondeleti* and *vinciguerra*. We have left for consideration only the present species and *rufipinnis*, and of these, Artedi's species seems much more likely to have been the former than the latter.

The *speculiger* of Cuv. & Val. and the *affinis* of Günther we identify with the present species on the strength of Dr. Lütken's statement that on comparison of specimens, he finds it impossible to separate them. The scantily described *roberti*\* of Müller & Troschel seems also to be the same. It is a species with long anal and white markings on the pectorals. Presumably it has pale ventrals also, as it is compared by its describers with *E. cyanopterus*, and no difference in this regard is indicated.

The *E. noveboracensis* of Cuv. & Val. is also apparently the present species, but of this we cannot be quite certain.

Specimens of this species from points off our North Atlantic coast are in the National Museum. In the Museum of the Academy is a specimen 11½ inches long, collected by Isaac Tyson in the Atlantic.

### 8. *Exocætus rufipinnis*.

? *Exocætus exiliens*, Jenyns, Zool. Voy. Beagle, Fishes, 1842, 122 (not of Gmelin).

*Exocætus rufipinnis*, Cuvier & Valenciennes, Hist. Nat. Poiss., 1846, 99 (Payta, Peru); Günther, vi, 1866, 294 (copied); Jordan, Proc. Ac. Nat. Sci. Phila., 1884, 283 (re-description of original type).

*Exocætus dowi*, Gill, Proc. Ac. Nat. Sci. Phila., 1863, 167 (near Panama).

*Exocætus scylla*, Cope, Trans. Am. Phil. Soc. Phila., 1871, 481 (Tobasco, Mexico).

*Exocætus roberti*, Lütken, Vidensk. Meddel. Naturh. Forening, 1876, 12, 110 (Barbadoes; not of Müller & Troschel).

*Habitat*.—Tropical America.

The *Exocætus scylla* of Cope belongs apparently to a species different from *E. volitans*, and distinguished among other characters by the color of the pectorals.

The *Exocætus rufipinnis* of Cuv. & Val., too briefly redescribed by Professor Jordan, does not differ from *E. scylla* in any important respect so far as the description goes. The same is true of *Exocætus dowi*, which is certainly identical with *E. rufipinnis*. The type of *E. dowi* is lost, but a specimen from Panama is in the Academy of Sciences at San Francisco. While it is possible that these few specimens may represent more than one species, it is probable that *scylla*, *rufipinnis*, and *dowi* are the same. The specimen from Barbadoes, called *roberti* by Lütken, distinguished from *E. speculiger* by the uniformly colored pectorals, probably belongs to *E. rufipinnis*.

The following description is taken from the original type of *Exocætus scylla*:

\* The description of Müller & Troschel is very short. The following is the substance of it: "D. 11, A. 12; this species resembles *E. cyanopterus* Cuv. & Val., but it differs in the dorsal fin, which is much lower and of one color; the pectorals are diaphanous and dark colored, and on the inner part near the base is a large white spot." It is recorded by them as being very abundant about the Barbadoes.

Head,  $4\frac{1}{6}$  in length to last caudal vertebra; depth,  $5\frac{3}{4}$ . D., 11; A. 12; scales of lateral line, 58. Length of specimen,  $9\frac{1}{2}$  inches.

Body rather robust, not much compressed; head broad; interorbital area flat, its width 3 in head; eye rather small, its diameter  $3\frac{1}{2}$  in head; snout rather blunt, its length equal to diameter of eye; mouth large; length of maxillary  $4\frac{1}{4}$  in head.

Pectoral fin broad and long, its length  $1\frac{5}{11}$  in length of body; tips of pectorals scarcely reaching the last rays of dorsal fin; first ray of pectoral simple,  $1\frac{2}{7}$  in length of fin, second ray divided, third and fourth rays longest.

Origin of ventrals midway between posterior edge of preopercle and last caudal vertebra, their tips scarcely reaching last ray of anal; length of ventrals  $3\frac{1}{2}$  in length of body. First rays of dorsal and anal opposite each other (or nearly so); base of anal  $1\frac{1}{8}$  in base of dorsal; base of dorsal  $1\frac{1}{2}$  in head; lower lobe of caudal long, about one fourth longer than head, width of body at base of pectorals  $1\frac{2}{3}$  in length of head. Least depth of caudal peduncle about  $3\frac{2}{3}$  in length of head.

Posterior margin of preopercle nearly vertical, forming almost a right angle at its lower posterior extremity. Gill-rakers long, numerous, and slender.

About twenty-seven scales on lateral line before ventrals; about thirty scales between occiput and dorsal fin; six rows of scales between dorsal fin and lateral line.

Color uniform brownish above, silvery below. Pectorals colored like upper part of body, shading into darker toward their extremities; caudal uniform brownish, no dark markings on dorsal and anal fins; ventrals without distinct black markings.

#### 9. *Exocætes heterurus*.

*Exocætes ciliens*, Bloch, Ichthyol., taf. 392 (not of L.); Bloch & Schneider, Syst. Ichth., 1801, 429 (in part, copied).

*Exocætes heterurus*, Rafinesque, Caratteri di Alcuni Nuovi Generi, etc., 1810, 58 (Palermo).

† *Exocætes comatus*, Mitchill, Trans. Lit. and Phil. Soc. N. Y., 1815, 448, pl. 5, f. 1 (New York); De Kay, New York Fauna, Fishes, 1842, 231, pl. 36, f. 15 (after Mitchill); Storer, Synopsis Fish. N. A., 1846, 188; Lütken, Vidensk. Meddel. Natur. Foren., 1876, 106, f. 1 (36° W., 11° N.) (apparently a young form, with long mental barbel).

‡ *Cypselurus comatus*, Gill, Cat. Fish E. Coast, 1861, 38 (name only); Jordan & Gilbert, Syn. Fish. N. A., 1883, 381 (after Lütken).

*Exocætes noveboracensis*, Mitchill, Amer. Monthly Mag., ii, 1814, 233 (New York); De Kay, New York Fauna, Fishes, 1842, 230, pl. 36, f. 114 (after Mitchill); Storer, Syn. Fish. N. A., 1846, 188 (copied); Jordan & Gilbert, Syn. Fish. N. A., 1882, 904 (Wood's Holl, Mass.; Pensacola, Fla.).

‡ *Exocætes appendiculatus*, Wood, Journ. Ac. Nat. Sci. Phila., 1824, 283, pl. 17, f. 2 (young; S. coast United States).

*Exocætes volitans*, Cuv. & Val., xix, 1846, 83, pl. 559 (Toulon; Corsica; Nice; Genoa; Algiers); Günther, vi, 1866, 293 (copied); Steindachner, Ichthyol. Bericht., 1868, 68 (Alicante); Lütken, Vidensk. Medd. Nat. For., 1876, 10, 108 (St. Bartholomew; Gulf of Mexico; Naples; Nice); Doder-

lein, *Prospetto Metodico delle Specie Pesci*, 1879, 58 (Palermo); Vinciguerra, *Risultati Ittiologici del Violante*, 1883, 117; Day, *Fishes, Great Britain*, 1883, 155, pl. 228 (straggler to coast of England).

‡ *Exocætus lineatus*, Cuv. & Val., *Hist. Nat. Poiss.* xix, 1836, 92 (Gorea; Canaries); Günther vi, 1866, 287 (Madeira); Goode, *Bull. U. S. Nat. Mus.*, v, 1876, 76 (Bermudas; no description).

*Exocætus melanurus*, Cuvier & Valenciennes, xix, 1846, 101 (New York).

*Exocætus affinis*\*, Cope, *Trans. Amer. Phil. Soc.*, 1871, 481 (St. Martin's; no description).

*Habitat*—Atlantic Ocean, north to New York.

We have identified the common *Exocætus noveboracensis* of our Atlantic and Gulf coast with the *Exocætus volitans* of Cuv. & Val., as it agrees in all respects with their description, and also as Lütken affirms the identity of specimens from the West Indies with others from the Mediterranean. The *Exocætus volitans* of Linnæus cannot, however, be the same species, as already noticed, because Artedi, on whose account the species is based, enumerates eleven dorsal and eleven anal rays. The *Exocætus melanurus* of Cuv. & Val. seems to be the present species, as has been already noticed by Jordan & Gilbert. *Exocætus lineatus* of Cuv. & Val. and Günther is closely allied to this species, but it may possibly be distinct.

We have also referred to the synonymy of this species the bearded *comatus* of Mitchill and other authors. It appears to differ from *E. heterurus*, only in the presence of a long ribbon-like barbel at the chin. This is certainly a character of youth, and if the barbel were lost we do not see how *comatus* could be distinguished from *heterurus*.

We have, however, not examined any bearded examples of this species, and draw our knowledge of *comatus* chiefly from Lütken's figure. The *appendiculatus* of Wood seems to be identical with *comatus*.

The oldest name of this species seems to be that of *heterurus*,† Rafi-

\*The specimen noted by Professor Cope is in the museum of the Academy. It has the dorsal inserted much before front of anal. D. 13, A. 10.

† "The following is Rafinesque's original description:

"156. Sp. *Exocætus heterurus*.—Ale pectorali giungendo quasi alla coda e con 10 raggi, l'adominali situati più vicino della coda che del capo, ma non giungendo fino ad essa, lobo inferiore della coda più lungo, ala dorsale con 14 raggi, l'anali con 10. *Rondinone* Mong. Sic. ric. 2, p. 90. *Oss.* Questo pesce è abundantissimo nel golfo di Palermo nell' autunno mentre l'*E. exiliens* raramente visi vede, va allora in greggia nuotando e svolazzando a fiore d' acqua, e si pesca copiosamente con i palangari, onde alcune volte anche si sala; e giovani allora, lungo circa di otto pollici e si chiama *Aucileddu*, *Angiletto*, o *Rondenuni*; fra breve tempo abbandona i lidi, fuori alcuni puochi, che vi rimangono, e nella primavera vi ricompare per deporre l'ova ma in minor numero, e non più in turbe; allora è più grosso lungo un piede ed anche più e porta il nome *Aucilone*, si distingue facilmente dall' *E. exiliens* dal numero dei raggi dell' ale, sue adominali più corte, sua coda ineguale, etc., ha il capo depresso al di sopra; e mascelle senza denti, con l' inferiore più lunga della superiore, il dorso nero cerulescente, il ventre bianco-argentino, le ale pettorali color di rame al di sotto, con i raggi articolati e biforcati, l' adominali con 6 raggi dichotomi, giungendo un poco al di là dell' ano, la coda ineguale con 15 raggi e col labro superiore più piccolo e più corto dell' inferiore, al fin ha due linee laterali da ogni lato, di cui l' inferiore è molto bassa."

nesque. This name is applied by him to some species with short anal. His description agrees with the present form better than with any other. This species seems to be one of the most abundant in the Mediterranean.

The specimens examined by us are from  $9\frac{1}{2}$  to 15 inches in length, and are from the Atlantic and West Indies.

#### 10. *Exocetus robustus*.

? *Exocetus robustus*, Günther, vi, 1866, 289 (Australia).

*Habitat*.—Tropical seas.

The following description is taken from a specimen in the museum of the academy at Philadelphia :

Head  $4\frac{1}{4}$  in length of body ; depth  $5\frac{1}{5}$  ; D. 14 ; A. 9 ; 50 scales in lateral line ; length of specimen 9 inches. Body rather robust. Head broad, rather pointed forwards ; snout not very blunt,  $4\frac{1}{2}$  in length of head ; eye large,  $2\frac{3}{4}$  in head ; interorbital area flattish, 3 in head. Pectoral fins broad, their tips reaching posterior end of base of anal fin ; length of pectorals  $1\frac{2}{5}$  in length of body. Length of ventrals  $2\frac{3}{5}$  in length of body, their tips reaching nearly to posterior end of base of anal fin ; origin of ventrals midway between pupil and base of caudal fin. First ray of pectoral simple, its length little more than one-half length of fin ; second ray divided ; 23 scales before the ventrals ; 28 scales before the dorsal fin ; 7 rows of scales between lateral line and dorsal fin ; longest dorsal ray 2 in head ; lower lobe of caudal about one-fourth longer than head.

Color brownish above, silvery below ; pectoral black on its posterior half ; lighter on anterior, with a broad, white, oblique band which begins in the axil and extends about two-thirds across the fin ; ventrals white, dusky in axil ; dorsal and anal fin plain ; caudal dusky, with a black vertical bar across the base of its middle rays.

The single specimen from which the above description is taken agrees fairly with Dr. Günther's description of *E. robustus*. That description is, however, too incomplete for us to consider the identification as at all certain. Our specimen is said to be from "Cape San Antonio." Whether the cape in Cuba so named is intended, or some headland elsewhere, we are unable to say.

#### 11. *Exocetus furcatus*.

*Exocetus furcatus*, Mitchill, Trans. Lit. and Phil. Soc. N. Y., i, 1815, 149 (young, with barbel ; New York) ; De Kay, New York Fauna, Fishes, 1842, 231 (after Mitchill) ; Cuv. & Val., xix, 1846, 98 (copied) ; Günther, vi, 1866, 286 (India) ; Lütken, Vidensk. Meddel. Naturh. Foren., 1876, 400 (Mediterranean ; Atlantic ; Indian Ocean).

*Cypselurus furcatus*, Jordan & Gilbert, Syn. Fish. N. A., 1882, 380 (copied).  
*Exocetus nuttalli*, Le Sneur, Journ. Ac. Nat. Sci. Phila., 1821, 10, pl. iv, f. 1 (Gulf of Mexico) ; Gunther, vi, 1866, 286 (copied).

*Cypselurus nuttalli*, Swainson, Nat. Hist. Class'n, Fishes, ii, 1839, 296 (generic diagnosis).

*Exocetus (Cypselurus) procne*, De Filippi e Verany, Mem. Acad. Sci. Torino, ser. 2, xviii, 1857, 10, xviii, 5 (Nice).

*Exocetus maculipinnis*, Vinciguerra, Risultati Ittiologici del Viaggio, tav. i, f. 6, 1883, 113 (Tunis).

*Habitat*.—Warm seas, north to New York, and the Mediterranean.

Of this species we have examined three specimens, all of them in the museum of the academy at Philadelphia. The smallest of these ( $3\frac{1}{4}$  inches long; Atlantic; Bonaparte collection) is a typical *furcatus*, having at the chin two ribbon-like appendages, one attached to each side of the mandible a short distance from the symphysis. These barbels are a little shorter than the eye; they are black on their distal half. This specimen agrees well with the figure of De Filippi and Verany above cited (*E. procne*).

The two larger examples (one  $5\frac{1}{2}$ , the other 6 inches in length, both collected at Newport, R. I.) agree with the smaller one in all respects except that they show no traces of barbel. We are compelled to believe them the adult of *furcatus*, which species, therefore, loses the barbels with age. As this is certainly true in *Parexocetus mesogaster* also, we feel justified in regarding all bearded *Exoceti* as immature individuals.

We have placed, with Lütken, the *E. nuttalli* in the synonymy of *E. furcatus*. In Le Sueur's figure of *E. nuttalli* the barbels are represented as trilobate and as being attached near the angle of the mouth. They are also figured as longer than the head, but this may be true in a very young specimen, such as Le Sueur had before him. The coloration is that of the young of this species, and of several others.

The specimen described and figured by Vinciguerra as *Exocetus maculipinnis* agrees in all essential respects with the two larger (beardless) examples, which we refer to *E. furcatus*. We therefore regard it as belonging to this species, and as representing a form more mature than the "*procne*" and "*furcatus*," the "*nuttalli*" being a still younger form of the same.

The following description is drawn up from the two specimens from Newport:

Head  $4\frac{1}{2}$  in length to end of last caudal vertebra; depth  $5\frac{1}{4}$ ; D. 13; A. 9; lateral line with about 46 scales; length of specimens 6 and  $5\frac{1}{2}$  inches. Body rather slender, compressed. Head not very broad, much narrowed forward; the snout rather pointed; head more compressed than in other species. Interorbital area flat; its width at anterior margin of orbit equal to diameter of eye; 3 in head; at posterior margin of eye this is half greater. Mouth small; maxillary not reaching orbit; length of maxillary  $4\frac{3}{4}$  in head; length of mandible  $2\frac{1}{2}$  in head; length of snout  $4\frac{1}{3}$  in head; eye 3 in head. Pectoral fin long and broad; its length  $1\frac{2}{3}$  in length of body; tips of pectorals reaching to tenth ray of dorsal. First pectoral ray simple; slightly more than half length of fin; second ray divided; third and fourth rays longest. Origin of ventrals midway between posterior margin of eye and last caudal vertebra. Ventrals long;  $2\frac{1}{4}$  in length of body; their tips reaching past anal and almost to caudal fin. Dorsal fin rather high; its longest ray  $1\frac{1}{2}$  in head; longest anal ray about 2 in head. Origin of dorsal in advance of that

of the anal. Base of anal  $1\frac{2}{3}$  in base of dorsal; base of dorsal nearly equal to length of head. Lower lobe of caudal  $3\frac{1}{2}$  in body. About 23 scales on lateral line before ventrals, and about 29 in front of dorsal fin. Eight rows of scales between lateral line and dorsal fin. Color brownish above; silvery below. Pectoral fins black on lower posterior half; a broad white band running from axil obliquely back to the posterior of upper rays; some white on tips of pectoral rays. Anterior upper portion of the fin somewhat marbled. Ventral fins black, except on two outer rays, on inner ray, and a small spot on next two inner rays about one-fourth distance from origin of fin. Axil of ventrals pale. Dorsal fin, when depressed, showing three black spots; caudal fin with three dark transverse bands across fin; a black spot on tips of third, fourth, fifth, and sixth rays of anal fin.

## 12. *Exocætus cyanopterus*.

*Exocætus cyanopterus*, Cuv. & Val., xix, 1846, 98 (Bahia; Rio de Janeiro); Günther, vi, 1866, 294 (copied).

? *Exocætus, albidactylus*, Gill, Proc. Ac. Nat. Sci. Phila., 1863, 167 (Caribbean Sea, north of Brazil; erroneously ascribed to Panama).

*Habitat*.—Coast of Brazil.

We know nothing of this species except what is contained in the meager description of Valenciennes. In its coloration it approaches *E. bahiensis*, but the statement "D. 13, A. 12" would indicate that its place is in the group with the anal fin long, in the neighborhood of *E. volitans* and *E. rufipinnis*. From the latter it differs by the presence of a large black blotch on the dorsal.

We place here with doubt also the *E. albidactylus* of Gill, which seems to agree with *E. cyanopterus* except in the number of its fin rays ("D. 14, A. 10"). Possibly either Gill or Valenciennes has made an error in counting. The description of *E. albidactylus* indicates some resemblance to *E. bahiensis*, but the insertion of the ventrals, according to Gill's description, would be farther forward, much as in *E. furcatus*.

The type of *E. albidactylus* seems to be lost. Captain Dow, who collected it, has informed Professor Gilbert that it was taken in the Caribbean Sea, north of Brazil, and not at Panama.

## 18. *Exocætus nigricans*.

*Exocætus nigricans*, Bennett, Whaling Voyage, ii, 1840, 287; Günther, 1866, vi, 290 (Java).

*Exocætus bicolor*, Cuv. & Val., xix, 1846, iii (Atlantic); Bleeker, "Ned. Tydschr. Dierk., iii, 132."

*Exocætus spilopus*, Cuv. & Val., xix, 1846, 118. (La Rochelle, St. Helena, West Indies, India, Arabia, De Witt Land); Guichenot, Hist. Cuba. Ramon de la Sagra, Poiss., 1853, 152, pl. 4, f. 2 (Cuba); Lütken, Vid. Med. Nat. For., 1876, 107 (Indian Ocean).

*Habitat*.—Tropical seas, north to France.

This species is one of the most easily recognized in the group. It may be known at sight by the high dorsal fin, black on its posterior half, the posterior half of the ventral being also black.

Lütken has preferred the name *spilopus* to that of *nigricans*, because "it is not certain that the *nigricans* of Bennett, in which the black spot on the ventrals is situated at its base and not towards its extremity, is the same species." This element of doubt seems to us very slight. The *bicolor* is probably the same species, with the black on the ventrals faded into grayish blotches.

A specimen 10 inches long is in the museum of the academy from 18° S., 34° W. One, said to be from Central America, is in the National Museum.

#### 14. *Exocætus bahiensis*.

*Exocætus bahiensis*, Ranzani, "Nov. Comm. Acad. Sci. Inst. Bonon., v, 1842, 362, tab. 38" (Brazil); Günther, vi, 1866, 293 (Sumatra; Atlantic); Poey, Synopsis Pisc. Cub., 1868, 384, 385 (Cuba); Poey, Enum. Pisc. Cub., 1875, 121 (Cuba); Lütken, Vid. Medd. Naturh. Foren., 1876, 402, 108 (Indian Ocean).

*Exocætus vermiculatus*, Poey, Memorias Cuba; ii, 1861, 300 (Cuba).

*Exocætus spilonotopterus*, Bleeker, "Nederl. Tydschr. Dierk., iii, 1863, 113" (Sumatra).

? *Exocætus parva*, Poey, Syn. Pisc. Cub., 1868, 385; Poey, Enum. Pisc. Cub., 1875, 122. (Description insufficient; taken from an old drawing.)

*Habitat*.—Tropical seas; north to Cuba.

We have not studied this species. It is apparently closely related to *E. furcatus* and *E. nigricans*, differing from the former, so far as we know, in the coloration of its paired fins. From *E. nigricans* it further differs in the coloration of the dorsal fin.

*Exocætus parva* Poey, described from an old drawing, is too little known to be admitted as a species, or to receive any definite place in the synonymy.

The *Hirundo* of Catesby and the *Volador* of Parra are rough drawings of flying fishes, not recognizable as to the species.

#### 15. *Exocætus californicus*.

*Exocætus californicus*, Cooper, Proc. Cal. Acad. Sci., iii, 1864, 93, f. 20 (Santa Catalina Island); Günther, vi, 1866, 295 (copied); Jordan and Jouy, Proc. U. S. Nat. Mus., 1881, 13 (Santa Barbara); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 42, 457 (Santa Barbara, Santa Catalina, San Pedro, San Diego); Rosa Smith, Fishes San Diego, 1882 (Coronados Islands; no description).

*Habitat*.—Coast of Southern California.

Upwards of 400 examples of this species were obtained by Professors Jordan and Gilbert off Santa Barbara and San Pedro. In this region it is extremely abundant at the spawning season in the summer. It has not been recognized in any other locality nor at any other season. Its young is unknown. All the known examples are similar in size, 16 to 17 inches in length. It is probably the largest in size of all the flying fishes. It may be readily distinguished by the absence of distinct color markings and by the backward position of the ventrals.

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16. *Exocoetus callopterus*.

*Exocoetus callopterus*, Günther, vi, 1866, 292 (Panama); Günther, Fishes Central Amer., 1869, 479, pl. 83 (Panama); Lütken, Vidensk. Meddel. Naturh. Foren, 1876, 401, 107 (Panama).

*Exocoetus callopterus*, Jordan & Gilbert, Bull. U. S. Fish Comm., 1882, 109 (Panama).

*Habitat*.—Pacific coast of tropical America; Panama.

This species was found in some abundance at Panama by Professor Gilbert. It is one of the most strongly marked forms, readily distinguishable from other American species by the color of the pectorals. It needs further comparison with certain East Indian species which have the pectoral fins similarly marked.

17. *Exocoetus gibbifrons*.

*Exocoetus gibbifrons*, Cuv. & Val., xix, 1846, 118 (Atlantic).

*Habitat*.—Atlantic Ocean, Newport, R. I.

The description of Cuv. & Val. is very imperfect, and their species has not been recognized by any subsequent author. It is said to be "distinguished by the prominence or convexity of that part of the head before the eyes"; "the muzzle is, besides, short, not concave, but rather convex on the superciliary region."

These characters well distinguish a species represented, in the museum of the Philadelphia Academy, by a specimen 8 inches long, collected at Newport, R. I., by Samuel Powell.

This species has not been noticed by any recent author, and for it we adopt, for the present, the name of *E. gibbifrons*. The following is a detailed description of this specimen:

Head 4 in length to end of last caudal vertebra; depth  $5\frac{1}{2}$ . D. 12, A. 9. Lateral line about 46; length of specimen 8 inches.

Body robust, little compressed. Head rather short, interorbital area slightly concave, about  $\frac{1}{4}$  wider than eye; profile of snout convex, descending more abruptly than in any other of our species, making a decided curve downward. Snout rather blunt, 4 in head; eye 3 in head; maxillary  $4\frac{1}{2}$  in head; pectoral fins rather broad and long, their length  $1\frac{1}{2}$  in length of body; tips of pectorals reaching to tips of last rays of dorsal. First ray of pectoral simple, its length  $2\frac{1}{5}$  in length of fin; second ray simple, about  $\frac{1}{2}$  longer than first ray; third ray divided; fourth ray longest.

Origin of ventrals midway between posterior margin of eye and last caudal vertebra; length of ventrals 2.9 in length of body, their tips reaching to last ray of anal.

Origin of dorsal fin far in advance of the anal. Base of anal  $1\frac{3}{5}$  in base of dorsal. Longest dorsal ray  $2\frac{1}{5}$  in head, longest anal ray about

3 in head. Lower lobe of caudal about  $3\frac{1}{2}$  in body; least depth of caudal peduncle  $3\frac{1}{5}$  in head.

About 25 scales in lateral line before ventrals, and about 30 scales before dorsal; 7 scales between lateral line and dorsal fin.

Color, brown above, silvery below; on each scale on the upper part of the body is a darker brown spot near its posterior extremity. This gives the appearance of a dark-brown streak along each row of scales.

Pectorals uniformly colored, same color as upper part of body. Ventrals dusky, nearly black mesially, the posterior part of the fin still darker; no dark markings on dorsal or anal fins; caudal dusky, plain.

#### LIST OF NOMINAL SPECIES WITH IDENTIFICATIONS.

The following is a list of the nominal species referred to in the foregoing paper, arranged in chronological order, with our identification of each. Tenable specific names are printed in italics:

Nominal species.	Year.	Identification.
<i>Exocoetus volitans</i> , Linnaeus	1758	<i>Exocoetus volitans</i> .
<i>Exocoetus evolvans</i> , Linnaeus	1766	<i>Halocypselus evolvans</i> .
<i>Exocoetus exiliens</i> , Gmelin	1788	<i>Exocoetus exiliens</i> .
<i>Exocoetus mesogaster</i> , Bloch	1797	<i>Parexocoetus mesogaster</i> .
<i>Exocoetus heterurus</i> , Rafinesque	1810	<i>Exocoetus heterurus</i> .
<i>Exocoetus comatus</i> , Mitchell	1815	<i>Exocoetus heterurus</i> . (?)
<i>Exocoetus furcatus</i> , Mitchell	1815	<i>Exocoetus furcatus</i> .
<i>Exocoetus noveboracensis</i> , Mitchell	1817	<i>Exocoetus heterurus</i> .
<i>Exocoetus splendens</i> , Abel	1818	<i>Halocypselus evolvans</i> .
<i>Exocoetus nuttalli</i> , Le Sueur	1821	<i>Exocoetus furcatus</i> .
<i>Exocoetus fasciatus</i> , Le Sueur	1821	<i>Exocoetus exiliens</i> .
<i>Exocoetus appendiculatus</i> , Wood	1824	<i>Exocoetus heterurus</i> . (?)
<i>Exocoetus nigricans</i> , Bennett	1840	<i>Exocoetus nigricans</i> .
<i>Exocoetus bahiensis</i> , Ranzani	1842	<i>Exocoetus bahiensis</i> .
<i>Exocoetus lineatus</i> , Cuv. & Val	1846	<i>Exocoetus heterurus</i> . (?)
<i>Exocoetus speculiger</i> , Cuv. & Val	1846	<i>Exocoetus volitans</i> .
<i>Exocoetus cyanopterus</i> , Cuv. & Val	1846	<i>Exocoetus cyanopterus</i> .
<i>Exocoetus rufipinnis</i> , Cuv. & Val	1846	<i>Exocoetus rufipinnis</i> .
<i>Exocoetus melanurus</i> , Cuv. & Val	1846	<i>Exocoetus heterurus</i> .
<i>Exocoetus bicolor</i> , Cuv. & Val	1846	<i>Exocoetus nigricans</i> .
<i>Exocoetus rondeletii</i> , Cuv. & Val	1846	<i>Exocoetus rondeletii</i> .
<i>Exocoetus gibbifrons</i> , Cuv. & Val	1846	<i>Exocoetus gibbifrons</i> .
<i>Exocoetus spilopus</i> , Cuv. & Val	1846	<i>Exocoetus nigricans</i> .
<i>Exocoetus acutus</i> , Cuv. & Val	1846	<i>Fodiator acutus</i> .
<i>Exocoetus orbignianus</i> , Cuv. & Val	1846	<i>Parexocoetus mesogaster</i> . (?)
<i>Exocoetus georgianus</i> , Cuv. & Val	1846	<i>Halocypselus evolvans</i> . (?)
<i>Exocoetus monocirrhus</i> , Richardson	1846	<i>Halocypselus evolvans</i> . (?)
<i>Exocoetus roboriti</i> , Müller & Troschel	1846	<i>Exocoetus volitans</i> .
<i>Exocoetus hillianus</i> , Gosse	1851	<i>Parexocoetus mesogaster</i> .
<i>Exocoetus quadrimemis</i> , Gronow	1854	<i>Exocoetus volitans</i> . (?)
<i>Exocoetus (Cypselurus) procer</i> , Filippi & Verany	1857	<i>Exocoetus furcatus</i> .
<i>Exocoetus vermiculatus</i> , Poey	1858	<i>Exocoetus bahiensis</i> .
<i>Exocoetus chilensis</i> , Abbott	1860	<i>Halocypselus evolvans</i> .
<i>Exocoetus spilonopterus</i> , Bleeker	1863	<i>Exocoetus bahiensis</i> .
<i>Exocoetus dowii</i> , Gill	1863	<i>Exocoetus rufipinnis</i> .
<i>Exocoetus albidactylus</i> , Gill	1863	<i>Exocoetus cyanopterus</i> . (?)
<i>Exocoetus californicus</i> , Cooper	1864	<i>Exocoetus californicus</i> .
<i>Exocoetus obtusirostris</i> , Günther	1866	<i>Halocypselus evolvans</i> .
<i>Exocoetus affinis</i> , Günther	1866	<i>Exocoetus volitans</i> .
<i>Exocoetus robustus</i> , Günther	1866	<i>Exocoetus robustus</i> .
<i>Exocoetus brachycephalus</i> , Günther	1866	<i>Exocoetus rondeletii</i> . (?)
<i>Exocoetus callopterus</i> , Günther	1866	<i>Exocoetus callopterus</i> .
<i>Exocoetus lamellifer</i> , Kner & Steindachner	1866	<i>Exocoetus exiliens</i> .
<i>Exocoetus gryllus</i> , Klunzinger	1870	<i>Parexocoetus mesogaster</i> .
<i>Exocoetus scylla</i> , Cope	1871	<i>Exocoetus rufipinnis</i> .
<i>Exocoetus parra</i> , Poey	1875	<i>Exocoetus bahiensis</i> . (?)
<i>Exocoetus maculipinnis</i> , Vinciguerra	1883	<i>Exocoetus furcatus</i> .
<i>Exocoetus volador</i> , Jordan	1884	<i>Exocoetus rondeletii</i> .
<i>Exocoetus vinciguerræ</i> , Jordan & Meek	1885	<i>Exocoetus vinciguerræ</i> .

## RECAPITULATION.

We here repeat the list of species recognized by us, with a brief statement of such doubts as may exist in regard to them. The distribution of each species is indicated by the letters U (Atlantic coast of United States), C (California), W (West Indies and Brazil), A (Western Africa), E (Europe), P (Pacific coast of Mexico and Central America), G (west coast of South America), X (East Indies).

## GENUS 1.—FODIATOR, Jordan &amp; Meek.

1. *Fodiator acutus*, Cuv. & Val. P. W. A.

## GENUS 2.—PAREXOCÆTUS, Blecker.

2. *Parexocætus mesogaster*, Bloch. U. W. X.

## GENUS 3.—HALOCYPSELUS, Weinland.

3. *Halocypselus evolans*, Linnæus. E. A. U. W. G. X.

(Possibly includes two or three species.)

## GENUS 4.—EXOCÆTUS, (Artedi) Linnæus.

4. *Exocætus exiliens*, Gmelin. W. U. S.

(Name to be adopted possibly doubtful.)

5. *Exocætus rondeleti*, Cuv. & Val. E. U. W. A.

(Possibly the adult of *E. exiliens*.)

6. *Exocætus vinciguerræ*, Jordan & Meek. E. U.

7. *Exocætus volitans*, Linnæus. U. W. X. G. E. ?

8. *Exocætus rufipinnis*, Cuv. & Val. P. W.

(Possibly two species, *rufipinnis*, *scylla*, included under this name.)

9. *Exocætus heterurus*, Rafinesque. U. W. E. A.

(Possibly the bearded *E. comatus* is a different species.)

10. *Exocætus robustus*, Günther. W. ? X.

(Doubtful identification.)

11. *Exocætus furcatus*, Mitchill. U. W. E.

12. *Exocætus cyanopterus*, Cuv. & Val. W.

(Unknown to us; possibly includes two species, *cyanopterus*, *albidactylus*.)

13. *Exocætus nigricans*, Bennett. W. X. E.

14. *Exocætus bahiensis*, Ranzani. W. X. E.

15. *Exocætus californicus*, Cooper. C.

16. *Exocætus callopterus* Günther. P.

(Possibly identical with some East Indian species of prior name.)

17. *Exocætus gibbifrons*, Cuv. & Val. U.

INDIANA UNIVERSITY, February 24, 1884.